Analysing the Noise Sensitivity of Skeletonization Process

Attila Fazekas and András Hajdu

The necessity of designing skeletonization algorithms dates back to the early years of computer technology, to the 1950s. It was realised that in some applications (the first problem was the character recognition), it is enough to take only a reduced amount of information into account instead of the whole image, which is usually a line-drawing. The basic idea was to "peel" the original image by iteratively removing suitable contour points. This procedure is the so called skeletonization, which obtains a line-like shape (the skeleton), so the further analysis become more easily executable.

Many skeletonization algorithms have been analysed from several points of view in the past ten years to compare the results they produce. However it is very difficult to measure quantitatively the "goodness" of such a method. The analytical comparison of the methods is very sophisticated, since they are based on different models. This is the reason why the skeletonizations are compared according to the results they produce in the practice. There are papers about the technical parameters of these algorithms (like computation speed, memory requirement, etc.).

Our purpose is to analyse the "goodness" of skeletonizations from a special point of view. We found that the skeletonizations were not examined statisticaly (with a large number of experiments) to test how the noise corruption affects the extraction of the skeleton, and how the skeletonization processes can cope with noisy images. Unfortunately the input images are rarely ideal, but are corrupted with some kind of noise. For example, the contours in the image of a printed circuit board is often corrupted by a contour noise, which makes the contours disconnected, or thicker, etc.

Our purpose was to decide which is the most efficient algorithm for noisy images, among the investigated five one. A large database of 21000 skeletons was used to obtain performance indices for the algorithms. Linear correlation was detected between the level of the noise and the distance of the reference and test skeletons. The algorithms could be grouped according to their tolerance with respect to different types of noises and images. The calculated rank values of the algorithms may help someone to choose an algorithm which produces the most reliable result on a given type of image which is corrupted with a given type of noise. It seems to be interesting to go on with analysing other skeletonizations, which are based on other models, or to make investigations in higher dimension (3D).